and steel, terrestrial magnetism, and the means of obtaining the three magnetic elements.

In the second chapter, the various modern forms of the mariner's compass, and instruments for adjusting compasses without sights, are described with illustrations. There is much here which should be of value to commanders of ships anxious to know as much as possible of their best friend in navigation.

It is, however, to be regretted that in some particulars both text and illustrations belong to the past, for in Fig. 38 an imperfect idea is given of Sir W. Thomson's compass. The drawing was correct for 1877, but important improvements were made ten years ago in the substitution of the wire grummet suspension for india-rubber, a change attended with marked success in vessels propelled and severely shaken by powerful engines; also, in 1881, the adoption of a total reflection prism in the azimuth mirror instead of an ordinary piece of looking-glass.

Prominence is given to the Hechelmann compass card, which is intended to combine the principles of the Thomson card (which consist chiefly of a long period of oscillation and great lightness), with a much greater magnetic moment in the Thomson-Hechelmann card, as it may be termed. The chief difference in these cards lies in the arrangement of the needles, Hechelmann's idea being to suspend more powerful needles than Thomson's near the circumference, thus bringing the weight as far as possible from the centre of the card to produce a slow period.

In bringing powerful needles so near the circumference, it is easy to see that something has been lost by Hechelmann when the quadrantal deviation is to be corrected as it should be—a correction so perfectly accomplished by Thomson. The greater weight of the card, too, tends to increase friction at the cap and pivot. Under these considerations the Thomson-Hechelmann card can hardly be considered equal to the modern Thomson.

In the next chapter, which treats of the magnetism of ships and the resulting deviation, it is satisfactory to find that the different kinds of magnetism which careful investigation has shown to exist in modern vessels are specially mentioned. These are—

(1) Permanent magnetism.
(2) Sub-permanent (termed also retentive) magnetism.
(5) Transient magnetism.

These definitions are accompanied by a footnote stating that in the English text-books on deviation no difference is made between permanent and sub-permanent magnetism, but that the two are combined under the expression sub-permanent. This is perhaps rather hard upon some English books, where, by careful reading, it will be found that the distinction is really made, but, it must be confessed, with a want of that clearness of division which is important to sound knowledge. Readers of the papers published by the Royal Society, and more recently by the Royal United Service Institution, will find that the division of a ship's magnetism into the three kinds mentioned above is strongly insisted upon.

A complete analysis of the deviations of any given compass in a ship, and of the changes which take place on a change of latitude, is necessary before a satisfactory compensation of the deviation by magnets and soft iron can be made. In the "Compass on Board," this analysis has a chapter devoted to it, containing information which should be of value both to the captains of ships and compass adjusters. It is illustrated by many examples.

Values of the coefficients v and v', representing the temporary deviation caused by running on a given course for some days, are given for a number of vessels of different types, steam and sailing. They clearly show the navigator of a new ship the need of caution when altering course, and some idea of the amount of change of deviation he may expect; whilst it should be understood that no careful seaman would fail to learn and note the peculiarities of the iron affecting his ship's compasses from personal observation under the varied circumstances experienced during each voyage.

A corrector for the deviation caused by sub-permanent magnetism has yet to be discovered.

Taking a general view of this book, it may be described as calculated to provide good practical information for the officers of the German mercantile navy, as well as a certain amount of a theoretical nature for those inclined to learn something of a ship's magnetism from a higher standpoint.

The maps of the three magnetic elements provided at the end of the book are given for the epoch 1885, and on a larger scale than those usually provided in hand-books. The accompanying map of values of the secular change is somewhat open to criticism as regards the figures recorded in the Red Sea, Bombay, East Indies, and Australia. This, however, will not prove of any detriment to safety in practical navigation.

The difficulties connected with the compass in war-ships, with their armoured deck, thickly-plated sides, and conning-towers, are not treated of, and their officers must look elsewhere for the special information they require; still, there is much to be found in this book that will serve their purpose.

OUR BOOK SHELF.

Library Reference Atlas of the World. By John Bartholomew, F.R.G.S. (London: Macmillan and Co., 1890.)

THE recognition of the intimate connection that exists between physiography and geography is made very manifest, in all the atlases published during the last few years, by the insertion of maps indicating the physical features of the earth's surface.

We are in an eminently utilitarian age, and a collection of maps, to meet the requirements of the day, must serve more purposes than that of a mere index to the positions of places; it must represent the most permanent features of importance in commercial geography, and the distribution of commodities as explained by the sciences of physics, geology, meteorology, biology, &c., or collectively by physiography. The elegant work before us satisfies all these requirements, it is as complete as it is a trustworthy atlas of modern geography, and will be equally appreciated by the student, the business man, and the general reader.

The atlas contains 84 maps, and amongst them we find plates delineating drainage areas, ocean currents, prevailing winds, rainfall, temperature, climate, and commercial features. A characteristic of the collection is the large number of maps that have been devoted to the British Empire, eighteen plates being given of the United Kingdom alone. India is completed in eight plates, the Dominion of Canada is very completely represented in seven plates, and the mapping of all the British possessions

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has been carried out on the same elaborate scale. After the British Empire, special prominence has been given to the United States, whilst all the other countries of the world have been treated in a very comprehensive manner. The general reference index comprises the names of 100,000 places contained in the maps, and for British names it is the most complete ever published. One matter of regret, however, is that the places on some of the maps are not obviously visible because of the bright and superabundant colouring used to indicate the divisions of a country, for, generally speaking, these divisions are better represented by coloured lines. The less masking there is, the more distinct must places appear, and therefore the purpose of an atlas will be the better served. This is, however, but a minor point. The atlas is an excellent one, it is complete and accurate, contains all the results of recent exploration and geographical research, and is issued at a moderate price; its addition to every library therefore is a thing to be desired.

The Bala Volcanic Series of Caernarvonshire and Associated Rocks; being the Sedgwick Prize Essay for 1888. By Alfred Harker, M.A., F.G.S., Fellow of St. John's College, and Demonstrator in Geology (Petrology) in the University of Cambridge. (Cambridge: University Press, 1889.)

IN this useful little work, Mr. Harker has given an admirable *résumé* of the results which have, up to the present time, been arrived at by the study of the ancient igneous rocks of North Wales. Besides summarizing the work of the late John Arthur Phillips and E. B. Tawney, of Prof. Bonney, Mr. Rutley, Mr. Cole, Mr. Teall, Mr. Waller, Miss Raisin, and others who have written on the petrography of the district, he has added many new and often judicious notes on the rocks in question. A number of fresh analyses, and the description of hitherto unrecognized varieties of rocks and minerals, raise the work out of the category of mere compilations; and the excellent classification and arrangement of his materials make the book one eminently useful for purposes of reference. It is unfortunate that it has no index, though the "table of contents," which is very full and carefully paged, causes the want to be less felt than it otherwise would be. Mr. Harker classifies the districts of Caernarvonshire in which volcanic rocks are found as the *Eastern*, *North-Western*, and *Western*, the latter consisting of the Lleyn peninsula. He groups the types of rocks represented under the headings of "rhyolitic lavas," "nodular rhyolites," "acid intrusives," "intermediate rocks," "diabase sills and basalts," and "other basic intrusions." The work concludes with a "review of vulcanicity in Caernarvonshire," in which we find discussions of the relation of the volcanic eruptions to the earth-movements that took place at the period of their occurrence, the succession of lavas in the district, and the evidence in favour of their submarine origin. The book is admirably printed, and is illustrated by six very clearly-drawn sketch-maps. The essay is worthy of the memorial in connection with which it appears, and is creditable to the University under whose auspices it is issued; and higher praise than this it would be difficult to give to any work of the kind.

LETTERS TO THE EDITOR.

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The Inheritance of Acquired Characters.

WITHOUT expressing any opinion upon the question recently discussed in your columns under the above title, I think it may be as well to recall the belief of one whose judgment was not without weight, and to give some of the evidence on which that belief was founded.

In the first chapter of the "Origin of Species" (p. 8 of the sixth edition), Mr. Darwin says, respecting the inherited effects of habit, that "with animals the increased use or disuse of parts has had a more marked influence"; and he gives as instances the changed relative weights of the wing-bones and leg-bones of the wild duck and the domestic duck, and, again, the drooping ears of various domestic animals. Here are other passages taken from subsequent parts of the work:—

"I think there can be no doubt that use in our domestic animals has strengthened and enlarged certain parts, and disuse diminished them; and that such modifications are inherited" (p. 108). And on the following pages he gives five further examples of such effects. "Habit in producing constitutional peculiarities, and use in strengthening and disuse in weakening and diminishing organs, appear in many cases to have been potent in their effects" (p 131). "When discussing special cases, Mr. Mivart passes over the effects of the increased use and disuse of parts, which I have always maintained to be highly important, and have treated in my 'Variation under Domestication' at greater length than, as I believe, any other writer" (p. 176). "Disuse, on the other hand, will account for the less developed condition of the whole inferior half of the body, including the lateral fins" (p. 188). "I may give another instance of a structure which apparently owes its origin exclusively to use or habit" (p. 188). "It appears probable that disuse has been the main agent in rendering organs rudimentary" (pp. 400-401). "On the whole, we may conclude that habit, or use and disuse, have, in some cases, played a considerable part in the modification of the constitution and structure; but that the effects have often been largely combined with, and sometimes overmastered by, the natural selection of innate variations" (p. 114).

In his subsequent work, "The Variation of Animals and Plants under Domestication," he writes:—

"The want of exercise has apparently modified the proportional length of the limbs in comparison with the body" [in rabbits] (p 116). "We thus see that the most important and complicated organ [the brain] in the whole organization is subject to the law of decrease in size from disuse" (p. 129). He remarks that in birds of the oceanic islands "not persecuted by any enemies, the reduction of their wings has probably been caused by gradual disuse." After comparing one of these, the water-hen of Tristan D'Acunha, with the European water-hen, and showing that all the bones concerned in flight are smaller, he adds:—"Hence in the skeleton of this natural species nearly the same changes have occurred, only carried a little further, as with our domestic ducks, and in this latter case I presume no one will dispute that they have resulted from the lessened use of the wings and the increased use of the legs" (pp. 286-87). "As with other long-domesticated animals, the instincts of the silk-moth have suffered. The caterpillars, when placed on a mulberry tree, often commit the strange mistake of devouring the base of the leaf on which they are feeding, and consequently fall down; but they are capable, according to M. Robinet, of again crawling up the trunk. Even this capacity sometimes fails, for M. Martins placed some caterpillars on a tree, and those which fell were not able to remount and perished of hunger; they were even incapable of passing from leaf to leaf" (p. 304).

Here are some instances of like meaning from vol. ii.:—

"In many cases there is reason to believe that the lessened use of various organs has affected the corresponding parts in the offspring. But there is no good evidence that this ever follows in the course of a single generation. . . . Our domestic fowls, ducks, and geese have almost lost, not only in the individual but in the race, their power of flight; for we do not see a chicken, when frightened, take flight like a young pheasant. . . . With domestic pigeons, the length of sternum, the prominence of its crest, the length of the scapulæ and furcula, the length of the wings as measured from tip to tip of the radius, are all reduced relatively to the same parts in the wild pigeon." After detailing kindred diminutions in fowls and ducks, Mr. Darwin adds, "The decreased weight and size of the bones, in the foregoing cases, is probably the indirect result of the reaction of the weakened muscles on the bones" (pp. 297-98). "Nathusius has shown that, with the improved races of the pig, the shortened legs and snout, the form of the articular condyles of the occiput, and the position of the jaws with the upper canine teeth projecting in a most anomalous manner in front of the lower canines, may be attributed to these parts not having been fully exercised.

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